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Published in:

Philosophy Of Science, The Proceedings Of The 20th World Congress Of Philosophy, vol. 10, 79-88

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version

Publisher's PDF, also known as Version of record

Publication date:

2001

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Kuipers, T. A. F. (2001). Epistemological positions in the light of truth approximation. *Philosophy Of Science, The Proceedings Of The 20th World Congress Of Philosophy*, vol. 10, 79-88, 10, 79-88.

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Epistemological Positions in the Light of Truth Approximation

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ABSTRACT: I discuss in a systematic order the most important epistemological positions in the instrumentalism-realism debate, viz., instrumentalism, constructive empiricism, referential realism, and theory realism. My conclusions are as follows. There are good reasons for the instrumentalist to become a constructive empiricist. In turn, the constructive empiricist is forced to become a referential realist in order to give deeper explanations of success differences. Consequently, there are further good reasons for the referential realist to become a theory realist.

The nature of proper theories, that is, theories using theoretical terms, or rather the attitude one should have towards them is the subject of the ongoing realism-instrumentalism debate. We will sketch the most important epistemological positions in this debate. They will be ordered according to their answers to a number of successive leading questions, where every next question presupposes an affirmative answer to the foregoing one. Besides including the answer to questions concerning truth, we will also include the most plausible answer to questions concerning truth approximation. The survey is restricted to the natural sciences and hence to the natural world. It should be stressed that several complications arise if one wants to take the social and cultural world into account. However, the present survey may well function as a point of departure for discussing epistemological positions in the social sciences and the humanities. The survey will primarily be presented in terms of the two-level distinction between observational laws and proper theories, and hence of the short-term dynamics to which that distinction gives rise. That is, proper theories are evaluated and compared in terms of the observational laws they are able to explain and predict. From time to time we will also take the long-term dynamics into account generated by the transformation of proper theories into observation theories and giving rise to a multi-level distinction according to which proper theories may not only explain or predict a lower level observational law, but also be presupposed by a higher level one. Finally, we will talk about two versions of the natural world, the one called the actual world, that is, the natural world of the past, the present and the future, the other called the real world, that is, the natural world in the sense of all conceivable possibilities that are physically possible. We will also call these versions of the natural world the actual (or instantial) and the modal version, respectively. The actual world is of course in some sense part of the real world. The two versions will lead to two versions of each position, that is, the instantial version, merely pertaining to the actual world, and the modal version, which also pertains to the real world.

At the end we will briefly indicate the implications of the results of the study of empirical progress and truth approximation in Structures in Science (manuscript) for the way epistemological positions are related. This will be elaborated in the presentation. Taking the variety of (versions of) positions seriously implies that the notions of 'true' and 'false' are assumed to have adapted specifications. The same holds

for the notion of 'the truth', but it should be stressed in advance that it will always be specified in a domain-and-vocabulary relative way. Hence, no language independent metaphysical notion of 'The Truth' is assumed.

The first question really is not an epistemological question, but a preliminary ontological question.

Question 1: Does a natural world that is independent of human beings exist?

The question of whether there is a human-independent natural world is to some extent ambiguous. If one thinks in terms of a conceptualized natural world, that is, a world that in some way or other brings one or more conceptualizations with it, then one has to assume either a kind of essences underlying the natural world, or one has to assume a non-human designer of the natural world, or some human intervention. We take the question in the other sense, that is, does a non-conceptualized natural world independent of human beings exist? If one answers this question negatively one takes the position of (straightforward) ontological idealism. If one answers it positively we will speak of ontological realism. It is certainly questionable (Rescher 1992) whether so-called idealists, like Berkeley, really subscribed to ontological idealism. However this may be, and this is our main argument, it is highly implausible and not taken seriously by natural scientists. The positive answer may be plausible in the instantial version, it is not evident in the modal version. To speak meaningfully about physical possibilities seems to require at least some conceptualization. However, in the same way, to say something specifically about the actual world presupposes some conceptualization. Hence, as far as the role of conceptualizations is concerned, it can be argued that if one believes in an unconceptualized actual world, which can be conceptualized in different ways, one may equally well believe in an unconceptualized real world, which can be conceptualized in at least as many ways. To be precise, there are more, because to conceptualize the real world it is plausible to take also dispositions into account which do not seem to be of any use in characterizing the actual world. Apart from the comparable (epistemological!) role of conceptualizations, it is clear that modal ontological realism makes a stronger ontological claim than instantial ontological realism. In the following, we leave the choice between them open.

The second question is really epistemological.

Question 2: Can we claim to possess true claims to knowledge about the natural world?

Again it is important to first eliminate some ambiguities in this question. A positive answer to this question does not presuppose that true claims can be known to be true with certainty in some fundamental sense, nor that they can be verified or can be recognized as true or can be obtained in some other way. A positive answer evidently does not presuppose that the true claims the question refers to do not depend on a conceptualization, for the formulation of claims requires a vocabulary. What is intended is only that the claim that we can have good reasons for assuming that certain claims, by definition phrased in a certain vocabulary, about the natural world are true in an objective sense, whereas others are false. The negative answer amounts to the position of epistemological relativism, the positive answer may be called

epistemological realism, with an instantial and a modal version, depending on whether all of these claims are just claims about the actual world or some about the real world. As with the position of ontological idealism, the position of epistemological relativism is hard to take seriously in some straightforward sense, despite the fact that it seems to be fashionable in certain, so-called postmodern, circles.

The third question brings us to the heart of the distinction between observational and theoretical terms. Assuming a certain definition of observability and hence of the border between observational and theoretical terms, the following question arises:

Question 3: Can we claim to possess true claims to knowledge about the natural world beyond what is observable?

In other words, the third question is whether more than observational knowledge, that is knowledge in observational terms, is possible? A negative answer only makes sense of course if the notion of observability is relatively fixed. Our human observation possibilities might be extended, or just change, due to some evolutionary or artificial change of our physiological abilities. Moreover, they might be extended by accepting some observational laws, that enable the definition of new concepts. However, in case of the negative answer, one has to exclude the possibility of extension of the observable on the basis of the acceptance of proper theories. In other words, the transformation process of proper theories into observation theories, such as the atomic theory of matter became for nuclear physics, has then to be conceived as merely a way of speaking, giving rise to other kinds of as-if-behavior. A positive answer to the present question amounts to so-called scientific realism, according to which proper theories, or at least theoretical terms, have to be taken seriously. A negative answer might be said to reflect observational realism or just empiricism.

As a matter of fact, there are two well-known types of the negative answer to Q3. According to the first type, usually called instrumentalism, talking about reference of theoretical terms does not make sense, let alone talking about true or false (proper) theories. This way of talking reflects according to the instrumentalist a kind of category mistake by mistakenly extrapolating meaningful terminology for the observational level to the theoretical level. The only function of proper theories is to provide good derivation instruments, that is, they need to enable the derivation of as many true observational consequences as possible and as few false observational consequences as possible. Well-known representatives of the instrumentalist position among philosophers are Schlick, Toulmin (1953) and Laudan (1977). Moreover, although debatable, the physicist Bohr is a reputed instrumentalist, at least as far as quantum mechanics is concerned. Notice that it is plausible to make the distinction between an instantial and a modal version of instrumentalism depending on whether the relevant true and false observational consequences all pertain to the actual world or at least some to the real world.

According to the second type of negative answer to Q3, called (constructive) empiricism by its inventor and main proponent Van Fraassen (1980), there is no category mistake, that is, the point is not whether or not theoretical terms can refer and proper theories can be true or false. In fact such terms may or may not refer and such theories are true or false, but the problem is that we will never know this beyond

reasonable doubt. Hence, what counts is whether such theories are observationally true or false. Again there are two versions, instantial and modal empiricism, according to whether the theories are supposed to deal all with the actual world or at least some with the real world. Although Van Fraassen is clear about his non-modal intentions, the modal analogue has some plausibility of its own. That is, it makes perfect sense to leave room for observational dispositions, without taking theoretical terms of other kinds seriously. In other words, if one conceives dispositions in general, hence including observational dispositions, as theoretical terms, one may well reserve a special status for observational dispositions. In both versions, it makes sense to talk about the observational truth in the sense of the strongest true observational hypothesis about a certain domain of the natural world within a certain vocabulary. Assuming that it is possible to make sense of the idea that (the observational theory following from) one theory is closer to the observational truth than another, even convergence to the observational truth is possible. As suggested, Van Fraassen is a strong defender of instantial empiricism, where it should be remarked that his attitude is strongly influenced by his interest in quantum mechanics. Although Van Fraassen extrapolates this attitude to other proper theories, there are also scientists, in fact there are many, who take advantage of the fact that there may be examples of proper theories towards which an empiricist attitude is the best defensible one, whereas there are other examples towards which a realist attitude is the best defensible one. This gives rise to what Dorling (1992) has aptly called local positivist versus realist disputes, as opposed to the global dispute about whether it is a matter of yes or no for all proper theories at the same time. In this respect the empiricist attitude is usually identified with a position in the global dispute, the realist positions that follow usually leave room for local empiricist deviations from the globally realist attitude, as a kind of default heuristic rule.

As remarked already, for both types of empiricists, the long-term dynamics in science, according to which proper theories transform into observation theories, has to be seen as an as-if way of speaking. The question even arises whether this is really a coherent way of deviating from scientific practice where it seems totally accepted that the concept of observation is stretched to the suggested theory-laden interpretation.

Hence, it is time to turn to the positive answer to Q3, that is, to the position called scientific realism. Since the books by Hacking (1983) and Cartwright (1983) there is a weaker version of realism than the traditional one, which is suggested by the next question.

Question 4: Can we claim to possess true claims to knowledge about the natural world beyond (what is observable and) reference claims concerning theoretical terms?

Whereas Hacking and Cartwright, when answering this question in the negative sense, primarily think of reference of entity terms, and call their position entity realism, it is highly plausible to extrapolate that position to attribute terms, in some plausible sense of reference, and speak of referential realism. (2) According to referential realism, entity and attribute terms are intended to refer, and frequently we have good reasons to assume that they do or do not refer. Again it is possible to distinguish an instantial and a modal version, not only with respect to observational consequences, but also with respect to theoretical terms. For instance, when one takes the existence of atoms in the actual world seriously, which goes beyond empiricism, it is also defensible to

take the existence of physically possible atoms seriously, even if they do not (yet) exist in the actual world. In a sense this is just a definition of (existence in) the real world, as encompassing the actual world. Moreover, in both versions it is possible that one theory is observationally and referentially closer to the truth than another, as soon as we assume, in addition to the previous assumptions for observational truth approximation, that it is possible to define the idea that (the total referential claim of) one theory can be closer to the referential truth than another. Here, the referential truth is of course the strongest true referential claim which can be made by a certain vocabulary about a certain domain. However, since referentialists do not want to take theoretical induction seriously, that is, deciding to further assume that a certain proper theory is true (see further below), the transformation of proper theories into observation theories is for them no more open than for empiricists, i.e., it is open only in some as-if-reading. Referential realism seems, however, more difficult to defend than constructive empiricism, in particular when one takes the possibility of truth approximation into account. That is, as long as one is only willing to think in terms of true and false claims about theoretical terms when they are supposed to refer, one may be inclined to hold that most of these claims, past and future ones, are false. However, as soon as one conceives of sequences of such claims that may approach the truth, it is hardly understandable that the truth would not be a worthwhile target, at least in principle. Hence, let us turn to the suggested stronger position.

The positive answer to Q4 brings us to so-called theoretical or theory realism, in some version or another advocated by, for instance, Peirce, Popper (1963), and Niiniluoto (1987). (3) Theory realism shares with referential realism the claim that theoretical terms are supposed to refer, and that, from time to time, we have good reasons to assume that they refer, including the corresponding truth approximation claims. It adds to this the claim that theories are claimed to be true, and that we have from time to time good reasons to further assume that they are true, which is called theoretical induction. Moreover, proper theories can converge to the theoretical truth, that is, the strongest true claim that can be made, in a given vocabulary, about a specific domain, again leaving room for an instantial and a modal version. Although the truth to be approached is again domain-and-vocabulary relative, this does not exclude, of course, the possibility of comparison and translation of theories. Moreover, theoretical induction is always a matter for the time being, a kind of temporal default rule: as long as there is no counter-evidence, it is assumed to be true. This default-assumption not only implies that the theoretical terms of the theory then are assumed to refer, but also that the proper theory can from then on be used as an observation theory. Hence, the transformation process and the corresponding long-term dynamics are possible.

The last question to be considered is the following:

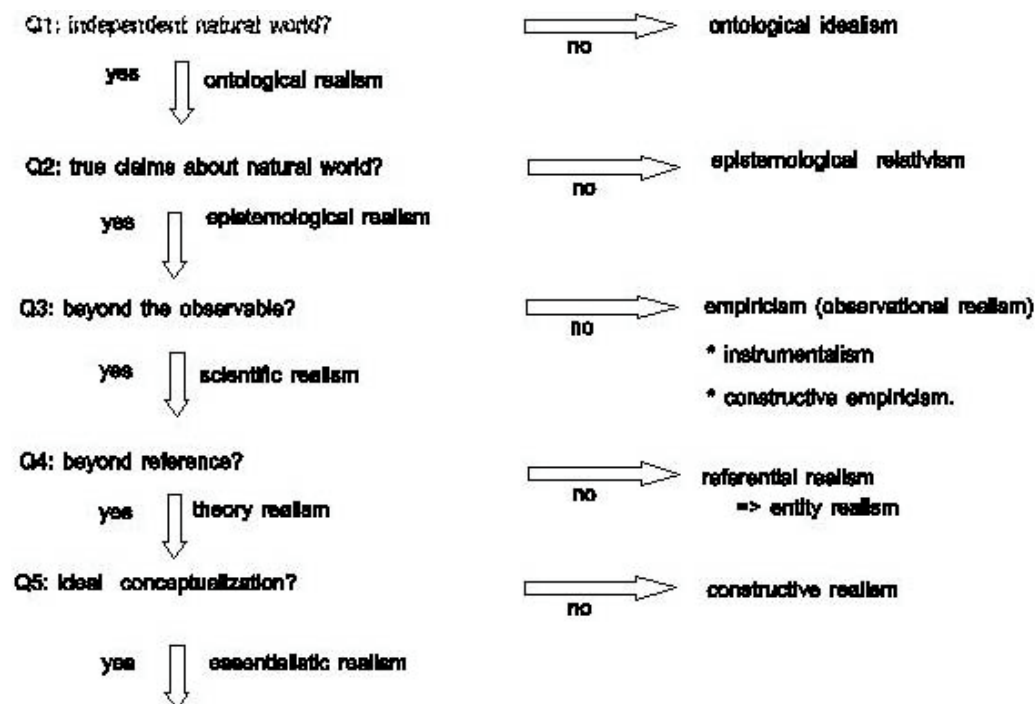
Question 5: Does there exist a correct or ideal conceptualization of the natural world?

In contrast to the positive answers on the questions Q2 to Q4, a positive answer to the fifth question brings us to a position that is not purely epistemologically built on the positive answer to Q1 (i.e., ontological realism), viz., it amounts to an extreme kind of metaphysical realism which we like to call essentialistic realism. The reason to call it this is, of course, that if there is an ideal conceptualization then the natural world must have essences of a kind. For instance, there must be natural kinds, not only in some

pragmatic sense, but in the sense of categories in which entities in the actual or the real world perfectly fit. Philosophers of science like Boyd (1984) and Harré (1986) seem to come close to this point of view. According to this extreme form of realism, the challenge of science is to uncover the ideal conceptualization, that is, to discover and extend the ideal vocabulary, on the basis of which perfect observational, referential and theoretical truths can be formulated. Refinement of this vocabulary is not so much directed at more precise and deeper truths, but at additional truths. Of course, it is possible to restrict the idea of an ideal vocabulary to an observational vocabulary, but there do not seem to be representatives of this kind of essentialistic empiricism. It will also be clear that there is again an instantial and a modal version, but if one is an essentialist, the modal version seems to be the most plausible one.

The negative answer to Q5 gives rise to what we call constructive realism. (4) The term was already used by Giere (1985) in more or less the same way. The difference is that Giere does not take truth approximation into account. Peirce, Popper and Niiniluoto, however, do take truth approximation into account. Moreover, whereas Peirce and Niiniluoto focus on the instantial version, Popper and Giere seem to have primarily the modal version in mind, without excluding the instantial version. In our view, the modal version of constructive realism is the best fit to scientific practice. The adjective 'constructive' is used for more or less the same reason as it is used by Van Fraassen, in his case restricted to the observational level. Vocabularies are constructed by the human mind, guided by previous results. Of course, one set of terms may fit better than another, in the sense that it produces, perhaps in cooperation with other related vocabularies, more and/or more interesting truths about the domain than another. The fruitfulness of alternative possibilities will usually be comparable, at least in a practical sense, despite the possibility of fundamental incommensurability. There is however no reason to assume that there comes an end to the improvement of vocabularies.

We summarize the preceding survey in the figure below.



The main epistemological positions

We consider the positions of instrumentalism, constructive empiricism, referential realism, and theory realism to be the main epistemological positions. Restricting the attention to their modal interpretation, they have been further characterized and compared in the light of the results of the analysis of empirical progress and truth approximation in *Structures in Science* (manuscript). Lack of space forces us to a brief indication here, to be elaborated in the presentation.

There are good reasons for the instrumentalist to become constructive empiricist; in his turn, in order to give deeper explanations of success differences, the constructive empiricist is forced to become referential realist; in his turn, there are good reasons for the referential realist to become a theory realist. The theory realist has good reasons to choose for constructive realism, since there is no reason to assume that there are essences in the world. Notice that the road to constructive realism amounts to a pragmatic argumentation for this position.

Besides these successive steps, there appear to be good reasons for all positions not to use the falsificationist but the 'evaluationist' methodology. That is, the selection of theories should exclusively be guided by more empirical success, even if the better theory has already been falsified. Hence, the methodological role of falsifications has to be strongly relativized. This does not at all imply that we dispute Popper's claim that aiming at falsifiable theories is characteristic for empirical science, on the contrary, only falsifiable theories can obtain empirical success.

The suggested hierarchy of the heuristics corresponding to the positions is, of course, not to be taken in a dogmatic sense, that is, when one is unable to successfully use the theory realist heuristic, one should not stick to it, but try weaker heuristics, hence first the referential realist, then the empiricist, and finally the instrumentalist heuristic. For, as with other kinds of heuristics, although not everything goes always, *pace* (the suggestion of) Feyerabend, everything goes sometimes. Moreover, after using a weaker heuristic, a stronger heuristic may become applicable at a later stage: "*reculer pour mieux sauter*."

Notes

(1) I would like to thank the Netherlands Institute for Advanced Study (NIAS, Wassenaar) for the ideal circumstances to write this paper, Anne Simpson for editing the English, and the members of the Promotion Club Cognitive Patterns (PCCP) in Groningen, in particular, Michel ter Hark, Erik Krabbe, Jasper Oosten and Esther Stiekema, for their useful comments.

(2) This term is used by Radder (1988), however, in a much stronger sense, viz., a strong version of constructive realism (below).

(3) See Niiniluoto (1984) for a lucid account of the relation between Popper, Peirce, and Whewell.

(4) The phrase 'nominalistic realism' would also be adequate if that were not generally conceived as a contradictio in terminis.

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